

CLAIMS

1. A fuel composition comprising:

(i) a fuel; and

5 (ii) a film-forming additive;

wherein the fuel comprises diesel and a fuel alcohol; and

wherein the film-forming additive is present in the fuel composition in an amount of less than 0.1 wt%.

10 2. A fuel composition according to claim 1 wherein the film-forming additive is present in the fuel composition in an amount of less than 0.01wt%.

3. A fuel composition according to claim 1 or 2 wherein the fuel alcohol is present in the fuel in an amount of 1 to 30% by volume.

15 4. Use of a film-forming additive for inhibiting and/or preventing cavitation in a fuel and/or reducing the effects of cavitation in a fuel, wherein the fuel comprises diesel and a fuel alcohol.

20 5. The invention according to any one of the preceding claims wherein the fuel further comprises a co-solvent.

6. The invention according to claim 5 wherein the co-solvent is an alcohol.

25 7. The invention according to claim 5 or 6 wherein the co-solvent has the formula $R^1O(CH_2CH_2O)_nH$, wherein n is a number from 0 to 10 and R^1 is a C_{1-30} hydrocarbyl group.

30 8. The invention according to any one of claims 5 to 7 wherein the co-solvent is selected from:

(i) $R^1O(CH_2CH_2O)_nH$ wherein n is 0 and R^1 is ethylhexyl; and

(ii) $R^1O(CH_2CH_2O)_nH$ wherein n is from 2 to 3 and R^1 is a C_5 to C_{15} alkyl.

35 9. The invention according to any one of the preceding claims wherein the fuel further comprises a surfactant.

10. The invention according to claim 9 wherein the surfactant has the formula $R^2(CO)_m-N(CH_2CH_2OH)_2$ wherein m is 0 or 1 and R^2 is a C_{1-30} -hydrocarbyl group.
- 5 11. The invention according to claim 10 wherein R^2 is a C_{8-22} hydrocarbon group.
12. The invention according to any one of claims 9 to 11 wherein the surfactant is selected from:
 - (i) $R^2(CO)_m-N(CH_2CH_2OH)_2$ wherein R^2 is a C_{18} alkenyl and m is 0; and
 - 10 (ii) $R^2(CO)_m-N(CH_2CH_2OH)_2$ wherein R^2 is a saturated or unsaturated C_{17} hydrocarbon and m is 1.
13. The invention according to any one of the preceding claims wherein the fuel further comprises a co-solvent of formula $R^1O(CH_2CH_2O)_nH$ wherein n is 0 and R^1 is ethylhexyl;
- 15 and a surfactant of formula $R^2(CO)_m-N(CH_2CH_2OH)_2$ wherein R^2 is a C_{18} alkenyl and m is 0.
14. The invention according to any one of claims 1 to 12 wherein the fuel further comprises a co-solvent of formula $R^1O(CH_2CH_2O)_nH$ wherein n is from 2 to 3 and R^1 is a C_5 to C_{15} alkyl; and a surfactant of formula $R^2(CO)_m-N(CH_2CH_2OH)_2$ wherein R^2 is a saturated or unsaturated C_{17} hydrocarbon and m is 1.
15. The invention according to any one of the preceding claims wherein the film-forming additive comprises a functional group selected from the group consisting of a carboxylic acid, a carboxylic ester, an alcohol, an amide and an amine.
16. The invention according to claim any one of the preceding claims wherein the film-forming additive is one or more compounds selected from the group consisting of:
 - (a) a C_5-C_{100} hydrocarbyl substituted with at least one carboxylic acid group;
 - 30 (b) the reaction product of a C_5-C_{100} hydrocarbyl substituted with at least one carboxylic acid group or comprising at least one carboxylic anhydride group with
 - (i) a reactive alcohol; and/or
 - (ii) an amine; and/or
 - (iii) an alcohol-amine; and/or
 - 35 (iv) an amino acid;

- (c) a polymeric hydrocarbyl substituted with a hydroxy group and/or substituted with a group comprising a nitrogen; and
- (d) an aromatic ring system substituted with a hydroxy group and/or substituted with a group comprising an amine and optionally substituted with a hydrocarbon group.

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- 17. The invention according to claim 16 wherein the C₅-C₁₀₀ hydrocarbyl is aliphatic.
- 18. The invention according to claim 16 or 17 wherein the C₅-C₁₀₀ hydrocarbyl is a C₅-C₁₀₀ hydrocarbon.
- 10 19. The invention according to any one of claims 16 to 18 wherein the C₅-C₁₀₀ hydrocarbyl is a C₅-C₁₀₀ alkyl or alkenyl.
- 15 20. The invention according to any one of claims 16 to 19 wherein the C₅-C₁₀₀ hydrocarbyl substituted with at least one carboxylic acid group comprises a terminal carboxylic acid group.
- 21. The invention according to claim 20 wherein the C₅-C₁₀₀ hydrocarbyl substituted with at least one carboxylic acid group is linear.
- 20 22. The invention according to claim 20 or 21 wherein the C₅-C₁₀₀ hydrocarbyl substituted with at least one carboxylic acid group is selected from the group consisting of lauric, myristic, myristoleic, palmitic, palmitoleic, stearic, elaidic, oleic and linoleic acid.
- 25 23. The invention according to any one of claims 16 to 19 wherein the C₅-C₁₀₀ hydrocarbyl substituted with at least one carboxylic acid group is substituted with at least two carboxylic acid groups.
- 30 24. The invention according to claim 23 wherein the C₅-C₁₀₀ hydrocarbyl substituted with at least two carboxylic acid groups is a dimer-acid.
- 25. The invention according to claim 23 wherein the C₅-C₁₀₀ hydrocarbyl substituted with at least two carboxylic acid groups is derived from maleic acid, maleic anhydride, succinic acid or succinic anhydride.

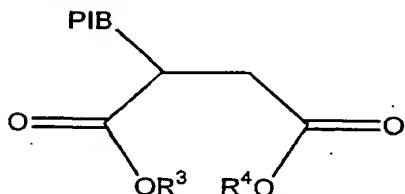
26. The invention according to any one of the preceding claims wherein the film-forming additive is the reaction product of a C₅-C₁₀₀ hydrocarbyl substituted with at least one carboxylic acid group or comprising at least one carboxylic anhydride group with a reactive alcohol.

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27. The invention according to claim 26 wherein the reactive alcohol is a diol, a triol or a polyol.

28. The invention according to claim 26 or 27 wherein the reactive alcohol is selected from the group consisting of ethylene glycol, propylene glycol, butylene glycol, glycerol, pentaerythritol and oligomers thereof.

29. The invention according to any one of claims 26 to 28 wherein the film-forming additive is a compound of formula



wherein PIB is a polyisobutene group having an average molecular weight of from 200 to 300 and R³ and R⁴ are independently selected from -CH₂CH₂OH, -CH(CH₃)₂, and H with the proviso that R³ and R⁴ are not both H.

20 30. The invention according to claim 28 either R³ and R⁴ are both -CH₂CH₂OH or one of R³ and R⁴ is -CH₂CH₂OH and the other is -CH(CH₃)₂.

31. The invention according to claim 16 wherein the polymeric hydrocarbyl is a polymer of C₂-C₁₀ hydrocarbon monomers.

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32. The invention according to claim 31 wherein the polymeric hydrocarbyl is a polymer of C₂-C₄ hydrocarbon monomers.

33. The invention according to claim 31 or 32 wherein the polymeric hydrocarbyl is a primary alcohol.

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34. The invention according to claim 31 or 32 wherein the polymeric hydrocarbyl is substituted with a group comprising an amide group.
35. The invention according to claim 16 wherein the substituted aromatic ring system is the product of a Mannich reaction.
36. The invention according to any one of the preceding claims wherein the fuel alcohol is an aliphatic alcohol.
- 10 37. The invention according to any one of the preceding claims wherein the fuel alcohol is an alkanol comprising an alkyl group and a hydroxy group.
- 38 . The invention according to claim 37 wherein the alkyl group is linear.
- 15 39. The invention according to any one of the preceding claims wherein the fuel alcohol is a C₁-C₁₀ alcohol.
40. The invention according to any one of the preceding claims wherein the fuel alcohol is a C₁-C₅ alcohol.
- 20 41. The invention according to any one of the preceding claims wherein the fuel alcohol is selected from methanol, ethanol, propanol and isopropanol.
- 25 42. The invention according to any one of the preceding claims wherein the fuel alcohol is ethanol.
43. A process for supplying a fuel composition to a combustion engine wherein the process comprises
 - (i) pumping the fuel composition with a rotary pump to supply the fuel composition to the
- 30 combustion engine
wherein the fuel composition comprises diesel, a fuel alcohol and a film-forming additive.
44. A process according to claim 43 wherein the pump supplies the fuel composition to the combustion engine at a rate which under normal design operating conditions would
- 35 result in cavitation of the pump if operated with a fuel comprising diesel and the fuel



alcohol in the absence of the film-forming additive.

45. A process according to claim 43 or 44 wherein the fuel composition is as defined in any one of claims 1 to 42.

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46. A fuel composition as substantially hereinbefore described with reference to any one of the Examples.

47. A use as substantially hereinbefore described with reference to any one of the
10 Examples.

48. A process as substantially hereinbefore described with reference to any one of the Examples.